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10/767,065	01/29/2004	Toshiharu Furukawa	ROC920030268US1	5663

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EXAMINER

NADAV, ORI

ART UNIT PAPER NUMBER

2811

DATE MAILED: 10/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/767,065

Applicant(s)

FURUKAWA ET AL.

Examiner

Ori Nadav

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 03 October 2005.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-10, 25-28 and 33 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10, 25-28 and 33 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 January 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 9/19/05.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

**DETAILED ACTION*****Drawings***

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the at least one nanotube having a length that extends vertically into a second plate, as recited in claim 25, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 25-28 and 33 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. There is no support in the disclosure as filed for at least one nanotube having a length that extends vertically into a second plate, as recited in claim 25.

There is no support in the disclosure as filed for a gate electrode has a thickness approximately equal to the length of said at least one semiconducting nanotube, as recited in claim 33.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-10 and 33 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claimed limitation of a gate electrode gating said length, as recited in claim 1, is unclear as to what is it meant.

Art Unit: 2811

The claimed limitation of a gate electrode has a thickness approximately equal to the length of said at least one semiconducting nanotube, as recited in claim 33, is unclear as to whether the thickness of the gate electrode is the vertical or the horizontal thickness of the gate electrode.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 4-8 and 10, insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 102(e) as being anticipated by Farnworth et al. (6,858,891).

Farnworth et al. teach in figure 1 and related text a vertical semiconductor device structure, comprising:

a substrate 12 defining a substantially horizontal plane;

a source region 17;

a drain region 21;

Art Unit: 2811

a gate electrode 19 disposed on said substrate and being electrically insulated therefrom, said gate electrode positioned vertically between said source and drain regions;

at least one semiconducting nanotube 22 including a first end electrically coupled with said source region, a second end electrically coupled with said drain region, and a length extending vertically through said gate electrode between said first and second ends and being electrically insulated from said gate electrode, said gate electrode gating said length when a voltage is applied to said gate electrode to define a channel region for current flow from said source to said drain, and

an insulating layer disposed between said drain and said gate electrode for electrically isolating said drain from said gate electrode, an insulating layer disposed between said source and said gate electrode for electrically isolating said source from said gate electrode, wherein said at least one semiconducting nanotube is composed of arranged carbon atoms, wherein said at least one semiconducting nanotube defines a channel region of a field effect transistor having a channel along which current flow is regulated by application of a control voltage to said gate electrode, wherein said at least one semiconducting nanotube is oriented substantially perpendicular to said horizontal plane, and wherein said gate dielectric is disposed on said at least one semiconducting nanotube.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2-3,9 and 33, insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Farnworth et al.

Regarding claim 9, Farnworth et al. teach in figure 1 substantially the entire claimed structure, as applied to claim 1 above, except a plurality of semiconducting nanotubes extending vertically through said gate electrode. Farnworth et al. teach in figure 2 a plurality of semiconducting nanotubes 22 extending vertically through said gate electrode.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form a plurality of semiconducting nanotubes extending vertically through said gate electrode in Farnworth et al.'s device in order to use the device in an practical application which requires plurality of nanotubes.

Regarding claims 2-3, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to form the source and drain of a catalyst material effective for growing said at least one semiconducting nanotube in Farnworth et al.'s device in order to simplify the processing steps of making the device.

Art Unit: 2811

Note that the process limitations of forming the source and drain of a catalyst material effective for growing said at least one semiconducting nanotube, would not carry patentable weight in this claim drawn to a structure, because distinct structure is not necessarily produced.

Note that a “product by process” claim is directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See also *In re Brown*, 173 USPQ 685; *In re Luck*, 177 USPQ 523; *In re Fessmann*, 180 USPQ 324; *In re Avery*, 186 USPQ 161; *In re Wertheim*, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and *In re Marosi et al.*, 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a “product by process” claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in “product by process” claims or not. Note that the applicant has the burden of proof in such cases, as the above case law makes clear.

Regarding claim 33, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to form a gate electrode of a thickness approximately equal to the length of said at least one semiconducting nanotube in Farnworth et al.’s device in order to simplify the processing steps of making the device.

Claims 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jin et al. (6,250,984).



Art Unit: 2811

Jin et al. teach in figure 9 and related text a semiconductor device structure, comprising:  
a substrate 105;

an electrically conductive first plate 104 disposed on said substrate,

an electrically conductive second plate 100A disposed vertically above said first plate;

and

at least one nanotube having an end electrically coupled with said first plate and a

length that extends from said end vertically into said second plate; and

a dielectric layer 101A disposed between said second plate from said first plate, said

dielectric layer coating said length of said at least one nanotube such that said at least

one nanotube is electrically isolated from said second plate,

wherein said at least one nanotube has a conducting molecular structure,

wherein said at least one nanotube has a semiconducting molecular structure,

and

wherein said dielectric layer defines a coating that encases said at least one nanotube.

Jin et al. do not teach at least one nanotube extends into said second plate. It would have been obvious to a person of ordinary skill in the art at the time the invention was made to extend at least one nanotube into said second plate in Jin et al.'s device in order to adjust the amount of electron emission.

***Response to Arguments***

Applicant argues that Jin et al. do not teach at least one nanotube having a length that extends vertically into a second plate, as recited in claim 25.

There is no support in the disclosure as filed for at least one nanotube having a length that extends vertically into a second plate, as recited in claim 25.

Applicant argues that Farnworth et al. do not teach at least one semiconducting nanotube including a first end electrically coupled with said source region, and a second end electrically coupled with said drain region, as recited in claim 1, because Farnworth et al. teach that both ends of the nanotube 22 are coupled with the annular source 17, and drain 21 is coupled at a mid-length location of the nanotube 22 that is between the ends of the nanotube 22.

Claim 1 does not require that the first and second ends of the at least one semiconducting nanotube would be located at the bottommost and the topmost of the at least one semiconducting nanotube. Clearly the source region and the drain region in Farnworth et al.'s device are coupled to ends of the semiconducting nanotube. Therefore, Farnworth et al. teach at least one semiconducting nanotube including a first end electrically coupled with said source region, and a second end electrically coupled with said drain region, as recited in claim 1.

Art Unit: 2811

Applicant argues that Farnworth et al. do not teach a channel region of the nanotube is the length of nanotube between the first and second ends that are respectively coupled with the source and drain, as recited in claim 1.

Claim 1 does not require that the channel region of the nanotube is along the entire length of nanotube from the bottommost and the topmost of the at least one semiconducting nanotube. Therefore, Farnworth et al. teach a gate electrode gating said length when a voltage is applied to said gate electrode to define a channel region for current flow from said source to said drain, as recited in claim 1.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Art Unit: 2811

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ori Nadav whose telephone number is 571-272-1660. The examiner can normally be reached between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Loke can be reached on 571-272-1657. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Ori Nadav', is positioned above the printed name.

O.N.  
10/8/05

ORI NADAV  
PRIMARY EXAMINER  
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